MICOM®

# Micro400 LocalDataset

## User's Manual
## Model M421

GE
Electronic Services
Los Angeles
M139/4X

# MICOM Micro400
# MODEL M421
# LOCAL DATASET
# USER'S MANUAL
# Stock Number 800-1085

April 1982

***WARNING:***

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

If radio frequency interference is encountered after installation of the equipment, necessary corrective measures are required to reduce this interference. Information about recommendations for such measures can be obtained from the manufacturer. Contact MICOM Corporate Headquarters for assistance.

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***Table of Contents***

## HOW TO USE THIS MANUAL

The material in this manual covers information you will need for your Model M421 and rack-mount Model M4421. This User's Manual, just like your Model M421 Synchronous Local Dataset, is designed to be easy to use.

*Section 1 Do-It-Yourself Installation* contains a "bare bones" procedure for installing your Model M421.

*Section 2 Simple Ways to Operate Your Model M421* contains descriptions of the Model M421 unit operations and testing.

*Appendixes* contain details on a variety of Model M421 topics to help you solve your more "sticky" technical problems.

An *Index* is also provided. It is a subject index in alphabetical order.

## INTRODUCING THE Micro400 MODEL M421

The MICOM Micro400 Model M421 Synchronous Local Dataset is a specialized modem, designed specifically for short-haul data transmission and offers substantial cost savings to users because of its reduced complexity. As a local dataset, Model M421 is designed for use over telephone company private line metallic circuits. MICOM's local datasets meet the requirements of Bell Publication 43401, which defines specifications for operation over metallic circuits.

Like MICOM's other products, the Model M421 is designed for *do-it-yourself installation.* No special tools are required. It has a built-in self-test feature, and diagnostics are done by the user.

## SHORT-HAUL DATA TRANSMISSION

Conventional, long-haul modems operate at speeds to 9600 bps. At 4800 bps and above, these modems require costly, automatic, adaptive equalizers. These complex equalizers are designed to deal with a wide variety of telephone line impairments. However, they are totally unnecessary on telephone lines only a few miles long which use dc continuous metallic circuits. In addition, metallic circuits do not have the same bandwidth limitations as long-haul telephone circuits.

Private line metallic circuits are available in most parts of the United States for use with *local datasets* conforming to Bell Publication 43401. These circuits require the removal of loading coils used for normal voice usage. The telephone company sometimes charges a one-time fee for removing these coils.

Local datasets have two major advantages compared with modems. They are substantially cheaper (they can be purchased for the price of *one month's rental* of some long-haul modems) and they offer data transmission up to 19,200 bps for the same price as 1200 bps. They are therefore particularly cost-effective at high-speed.

It should be noted, however, that private line metallic circuits are not generally provided when the terminating points are served by different telephone company central offices. Two points which are physically close together may be served by different central offices, so physical proximity is not necessarily an indication that metallic circuits will be available. *Check with your phone company first for circuit availability.*

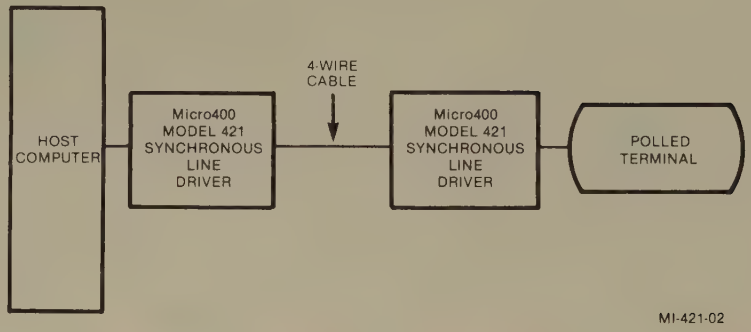
The local dataset includes filtering to ensure that the transmitted telephone line signal does not interfere with adjacent pairs in the same telephone cable. It is this filtering requirement which is defined in Bell Publication 43401. For use over customer-owned twisted pair cables, this filtering is not normally required, and a simpler, less costly *line driver* may be used. MICOM's Micro400 synchronous Line Drivers provide additional advantage of full-duplex operation over 4 wires (two pairs).

## Extending the EIA Interface

Line drivers are often used to connect terminals to a computer over distances of a few hundred feet, rather than several miles. Since the EIA RS-232 interface specification only requires operation up to 50 feet, no vendor, unless he is supplying the equipment at both ends of the cable and has checked out the operating environment, can guarantee error-free operation over distances greater than 50 feet. Although, in practice, EIA interface cables are normally adequate for distances of several hundred feet, the use of low-cost line drivers provides the *guarantee* of trouble-free operation beyond the 50-foot limit.

## APPLICATION

In the diagram below, Model M421 is shown as a general purpose short-haul line driver over a 4-wire cable.




***Synchronous Application***

# *SECTION 1*
# *DO-IT-YOURSELF INSTALLATION*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## GETTING READY TO USE SECTION 1

Section 1 is designed to be used as a self-sufficient document. However, you must come prepared. You must have answers for the following questions:

How is your Model M421 packaged (standalone or rack-mount)? (page 1-5)

What data rates will you use? (page 1-9)

What option configuration do you require? (page 1-11)

What voltage ac power will you use? (page 1-14)

What is your transmission distance? (page B-5)

## UNPACKING AND INSPECTING FOR DAMAGE

Your unit is packed completely assembled, ready for use.

Inside the shipping box, you should find (check the Packing List):

- Your Model M421
- This manual
- A cable

### Your Unit Should Arrive Safe and Sound

- MICOM *thoroughly inspected* and *carefully packed* your unit.
- The CARRIER *accepted responsibility* for its *safe delivery.*

### In Case of Damage

- Note visible damages *directly* on the freight bill and have the CARRIER *acknowledge* them.
- Report concealed damages to the CARRIER — *immediately upon discovery.*
- Submit damage claims to the CARRIER, *not to MICOM.*

## GETTING TO THE HEART OF YOUR MODEL M421

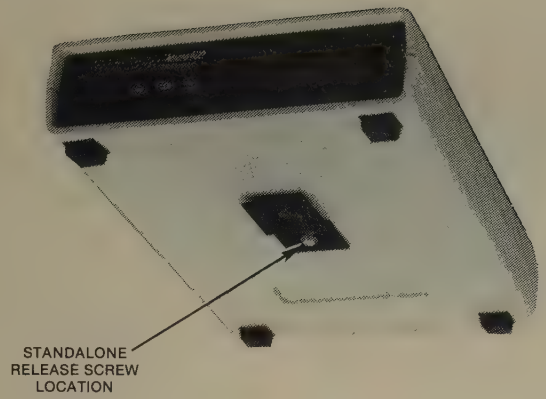
The initial step in do-it-yourself installation is to open your unit to gain access to the module located inside (see illustrations on the facing page).

### Standalone Units

a. Release the screw located on the bottom of the enclosure.
b. Carefully remove the top cover.

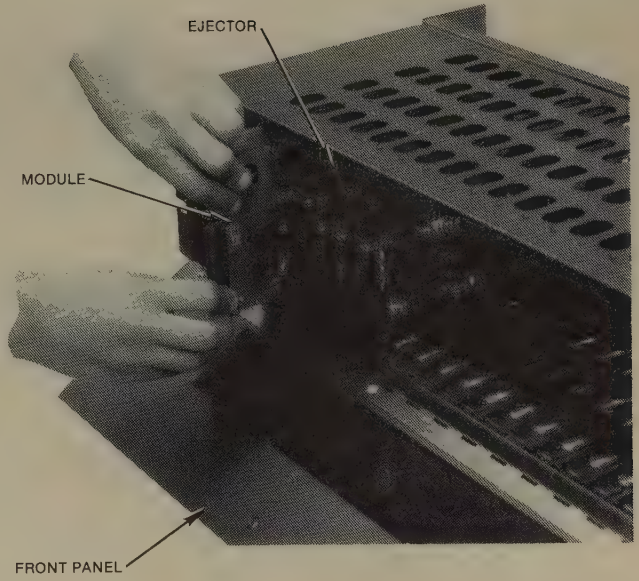
### Rack-Mount Modules

a. Open front panel.
b. Push up on card ejector.
c. Remove the module by gently pulling it from its socket and withdrawing it along its plastic guides.




MP-421-02.1c

***Access for Standalone Units***

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***Access for Rack-Mount Modules***

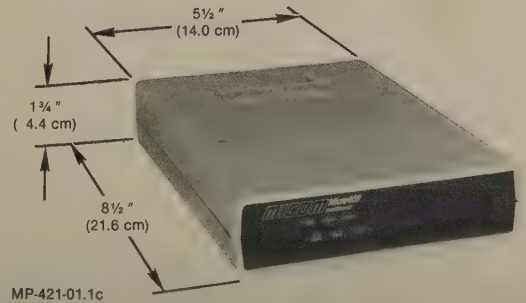
## SELECTING A LOCATION FOR YOUR MODEL M421

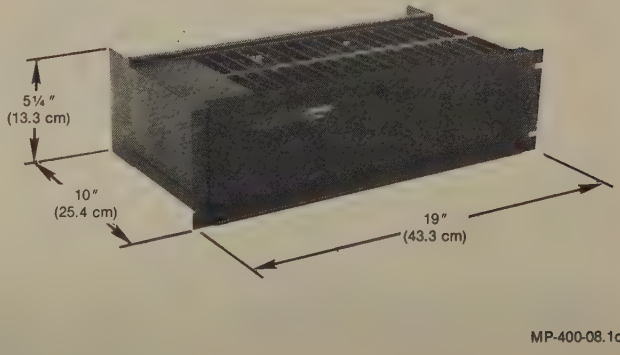
Your unit is designed and packaged for table-top placement or for rack-mount installation. It should be located near the equipment with which it interfaces and within 6 feet of a grounded outlet.

### *CAUTION*

Do not stack other equipment on top of your standalone. Make sure the rack-mount cabinet is adequately cooled.

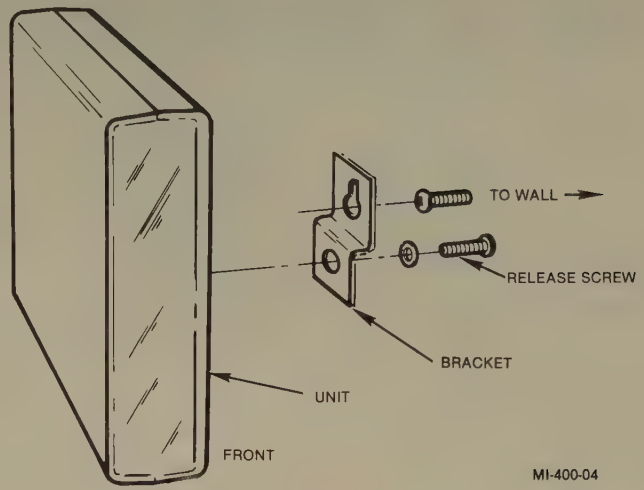
Provide sufficient space for cover removal, switch handling, and unobstructed air flow around your unit. Unit dimensions are given below.




***Dimensions***

A wall mount bracket is supplied for your standalone unit (shown below). To affix the unit, attach bracket to the bottom of the unit using the release screw. The unit may then be hung on a wall or any vertical surface.

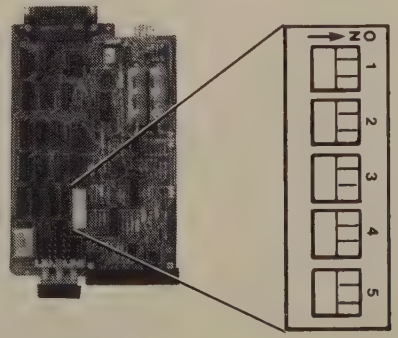



***Micro400 M421 Wall Mount***

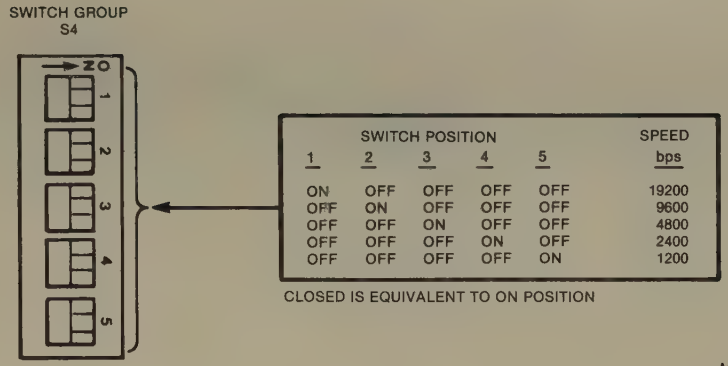
## SETTING THE CONFIGURATION SWITCH

Your Model M421 has one configuration switch group (see figure below). You can select five data rates via switch settings: 19,200, 9600, 4800, 2400, and 1200 bps. Line noise filters are incorporated with the selection of data rates. These filters provide optimum performance in a noisy line environment.

Selectable switch settings are shown in the figure on the facing page.




***Switch Group S4 Location*** MP-421-03.1




| SWITCH POSITION | | | | | SPEED |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | bps |
| ON | OFF | OFF | OFF | OFF | 19200 |
| OFF | ON | OFF | OFF | OFF | 9600 |
| OFF | OFF | ON | OFF | OFF | 4800 |
| OFF | OFF | OFF | ON | OFF | 2400 |
| OFF | OFF | OFF | OFF | ON | 1200 |

CLOSED IS EQUIVALENT TO ON POSITION

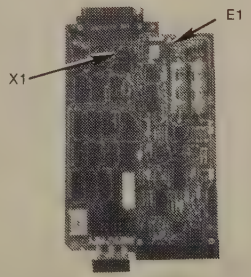
MI-421-03

***Switch Group S4 Switch Position Settings***

## HOW TO DETERMINE STRAPPING OPTIONS

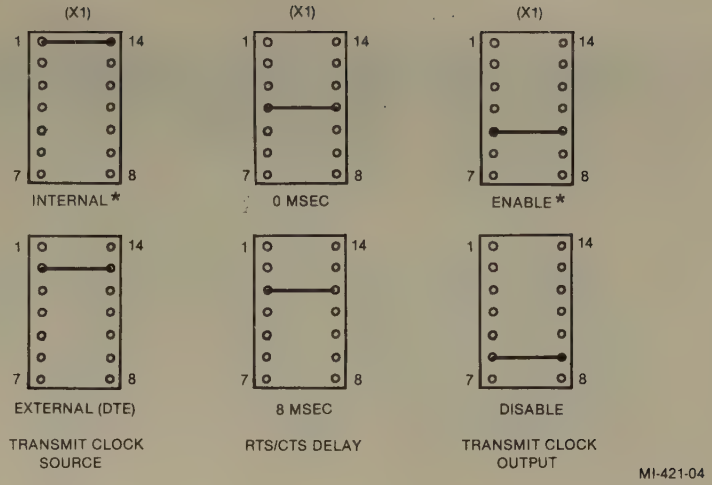
Your Model M421 has a 14-pin header socket (X1) which establishes options for operation. The options available are Transmit Clock Source, RTS/CTS Delay, and Transmit Clock Output. You may select these options by installing straps in the required configuration, as shown on page 1-11.

Signal ground and frame ground are normally separated to avoid ground loops and minimize noise in the Model M421. If you require a common reference for signal ground and frame ground, you must install a strap at E1. It is located as shown below.




MP-421-03.2

***Strap and Header Locations***



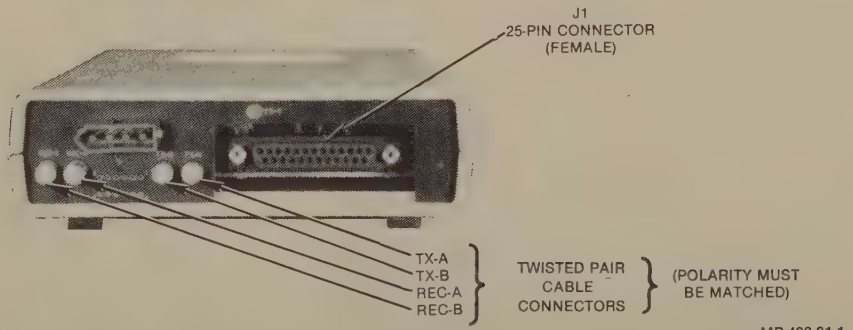

* NORMAL CONFIGURATION

***Header X1 Configurations***

## CONNECTING YOUR MODEL M421 (see also Appendix A)

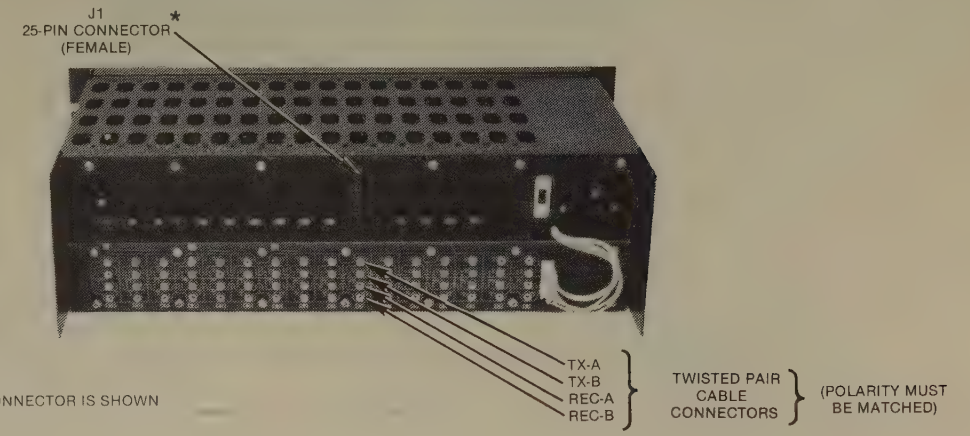
There are two cables you must connect to your Model M421: an interface cable from your data terminal equipment; and a telephone circuit cable.

The interface cable must be attached to the 25-pin interface connector at J1 (see the figure below for locations on the standalone unit and the figure on the facing page for locations on the rack-mount unit). The cable carries input/output data and control signals between the unit and your data terminal equipment.




***Standalone Unit Cable Connector Locations***

The cable connecting your transmit and receive lines must have dc continuity and may be a 4-wire privately-owned cable (two twisted pair) or a 4-wire telephone company metallic circuit. The cable should be connected to your standalone unit on the 4-screw terminal block as shown on the facing page. On the rack-mount chassis, the wire pairs are connected to the terminals in a similar fashion.



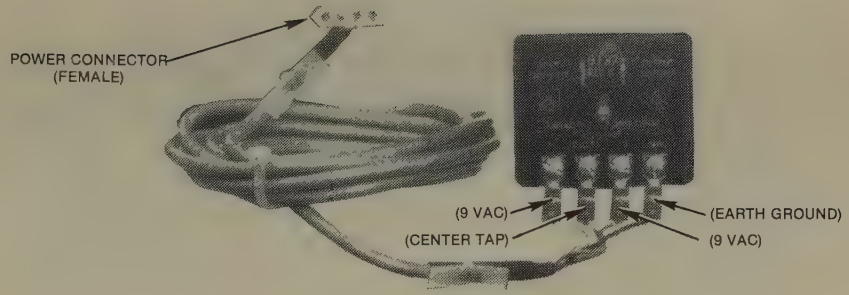

***Rack-Mount Chassis Cable Connector Locations***

## CHECKING YOUR MODEL M421 POWER SUPPLY

*Standalone Units.* Power is furnished to your standalone unit by a transformer module which is plugged into a 110 V ac wall outlet. The module consists of a transformer (18 V ac; secondary power center tap 9-0-9 V ac) with a three-prong plug and attaches to the standalone unit by a 6-foot, 4-conductor, low-voltage cord. (See illustration on the facing page.)

For export use, the transformer supplied is a 195-266 V ac unit, mounted in-line with the power cable.

The power connector is located on the rear panel of the standalone unit, as shown on the facing page.

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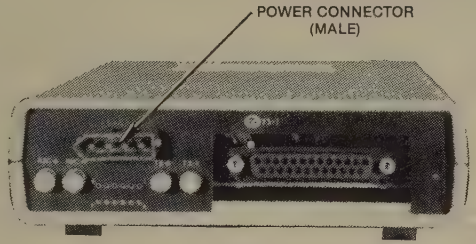
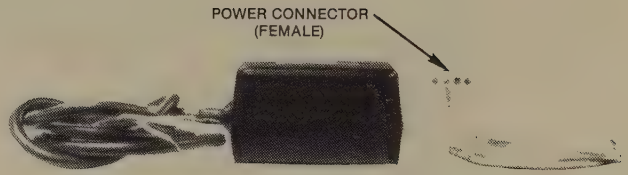
DOMESTIC TRANSFORMER
WITH CORD
(MICOM PART NUMBER 100-1701)




Micro400
(REAR VIEW)

MP-400-01.2c




EXPORT TRANSFORMER
WITH CORDS
(MICOM PART NUMBER 100-1878)

MP-400-04.1c

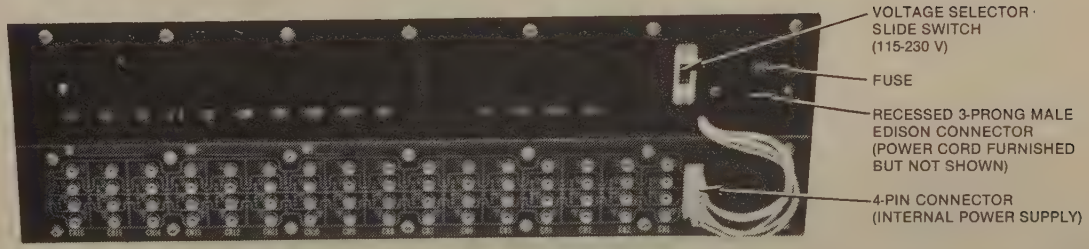
***Standalone Unit Power Connections***

*Rack-Mount Chassis.* Power is applied to your rack-mount chassis via a MICOM furnished 6-foot, 3-wire power cord (see illustration below).

Your rack-mount chassis power supply is normally set at the factory for 115 V (domestic) or 230 V (export) and fused for 2 or 1 amps, respectively. A spare fuse is provided. Both fuses are 3 AG, Slo-Blo.

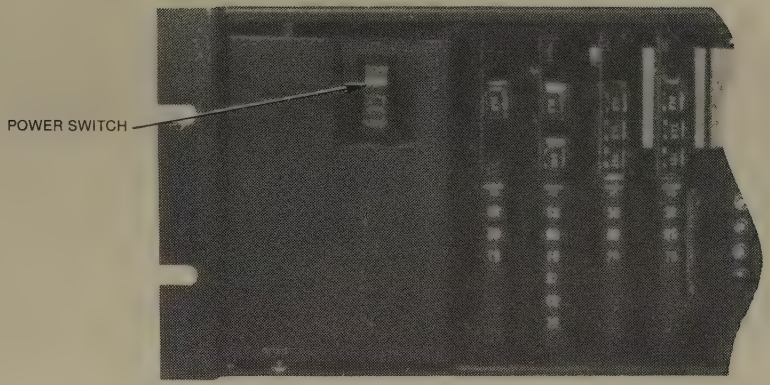
To apply power:

a. Set voltage selector slide switch to match line voltage requirements.
b. Install proper size fuse.
c. Open the front panel and make sure power switch is OFF (see illustration on the facing page).
d. Install power cord to chassis and outlet.
e. Set power switch ON.


VOLTAGE SELECTOR SLIDE SWITCH (115-230 V)
FUSE
RECESSED 3-PRONG MALE EDISON CONNECTOR (POWER CORD FURNISHED BUT NOT SHOWN)
4-PIN CONNECTOR (INTERNAL POWER SUPPLY)

***Rear View of Rack-Mount Chassis***

MP-400-02.2




(FRONT PANEL NOT SHOWN)

***Rack-Mount Chassis Power Switch***

MP-400-05.1

## APPLYING POWER TO YOUR MODEL M421 AND CHECKING FOR PROPER OPERATION

First, plug your unit into an outlet.

Second, replace the cover: for standalone units — replace the top cover and secure it with the release screw on the bottom of the enclosure; for rack-mount units — gently slide module into its socket and close the front panel.

Third, observe your system status display.

*Initialization:* When you first plug in your unit and communication is not yet established with the remote unit, the system status display should be:

**SR** - ON

*Normal Operation:* When communication has been established with your remote unit, your system status display should be:

**SR** - ON
**RD** - FLICKERING (as data is received)
**TD** - FLICKERING (as data is transmitted)

## SECTION 2

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## Contents

## HOW TO READ YOUR MODEL M421 DISPLAY

As shown below, your Model M421 has three LEDs. For clarity, the standalone model is shown with front cover removed.

The display functions are described in the table on the facing page.

MP-421-04.1

***Display Location***

| Display Legend | ON | OFF |
|---|---|---|
| SR | Data Set Ready (power on) | Power failure |
| RD | Received data in Space condition | Received data in Mark condition |
| TD | Transmitted data in Space condition | Transmitted data in Mark condition |

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***Display Functions***

## HOW TO DETECT AND ISOLATE FAULTS

### NOTE

This user's manual does not cover troubleshooting to the module or piece/part level. It covers only troubleshooting which can be performed by Model M421 operators.

The information following covers the common situations which may arise in the use of your unit. The isolation tests described are designed to be performed by the operator.

| Display | Probable Cause | Isolation/Tests |
|---|---|---|
| 1. All indicators OFF | Loss of power | a) On standalone units, check the power cord and connections.<br><br>b) On rack-mount units, check fuse and power supply connectors. |
| 2. **RD** indicator OFF, **TD** indicator FLICKERING | Loss of line | Check line connectors at both ends of the system. Place remote Model M421 into loopback test mode, the local terminal (or port) should receive its own data. (If **RD** remains OFF and own data is not received, call MICOM Customer Service* or replace the unit.) |
| 3. **TD** indicator OFF, or ON permanently. **RD** indicator FLICKERING | No transmit data | Check terminal and terminal-to-Model M421 interface. |

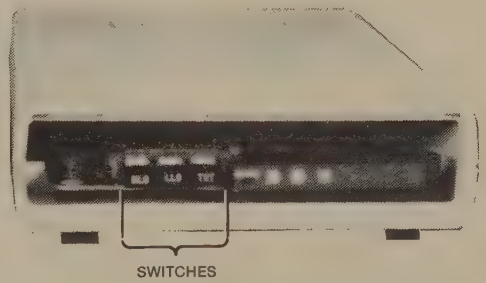
* See page 2-14.

MT-421-05

***Problems/Tests***

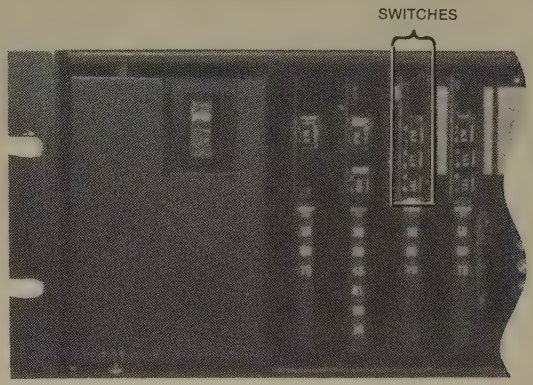
## How to Find Your Test Switches

The DLB (digital loopback), LLB (line loopback), and TST (test) switches used to test your Model M421 are located as shown in the illustration below and are accessible through a cut-out in the front panel. For clarity, the standalone model is shown with front cover removed.




***Test Switches for Standalone Unit***

The operating switches on your rack-mount module are accessible once the hinged plastic front is opened. The switches are mounted adjacent to the LEDs (see illustration below).




MP-400-05.4

***Test Switches for Rack-Mount Module***

## NOTE

It is recommended that the following diagnostic tests be run in the sequence in which they are presented.

The Data Terminal Equipment (DTE) noted in each data flow diagram is the terminal or computer port to which the unit is connected.

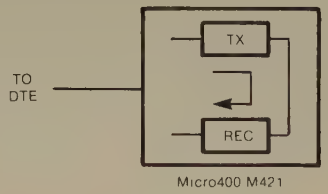
The TX and REC designations in the diagrams refer to transmitter and receiver, respectively.

## How to Run the Local Loopback Test

This test will verify the integrity of the unit under test.

To start this test, depress (engage) the LLB and TST switches. The **SR** light should go out and the **RD** light should flash once and then go out. This indicates that the unit is operating properly. If the **RD** light continues to flash, the unit under test is defective and should be replaced.

To end this test, depress (disengage) all test switches.




***Local Loopback Test Data Flow***

## How to Run the Full-Duplex Test

This will verify the end-to-end continuity of the communications circuit and the integrity of both units under test.

To start the test, depress (engage) the TST switch on the units at both ends of the system. If there is end-to-end continuity on the circuit under test, the following procedure will establish a demonstration of the condition.

When you engage the TST switch at the local end of the system, the **SR** light will go out and a momentary spurt of errors will be injected into the transmitter of the local unit. At the remote end, the unit will respond to these errors by FLASHING the **RD** light. This step may have to be repeated to ensure that the remote operator is observing the **RD** light at the time the local operator engages the TST switch. If the **RD** light does not FLASH at the remote end, check the communications link for impairments or refer to the appropriate telephone company.

To end this test, depress (disengage) all test switches.

***Full-Duplex Test Data Flow***

## How to Run the Line Loopback Test

This test will verify the condition of the local unit and the communications link.

***CAUTION***

This test may not be valid at extreme mileage ranges. Use the full-duplex test in that circumstance.

To start this test, instruct the operator of the remote unit to depress (engage) the LLB switch. If the terminal at the local unit has loopback testing capabilities, data may be sent to the remote unit and compared with data received from the remote unit. If the terminal does not have loopback testing capabilities, the TST switch may be used in place of the LLB switch. You may determine the condition of the local unit and the communications link by observing the **RD** light.

To end this test, depress (disengage) all test switches.

***Line Loopback Test Data Flow***

## How to Run the Digital Loopback Test

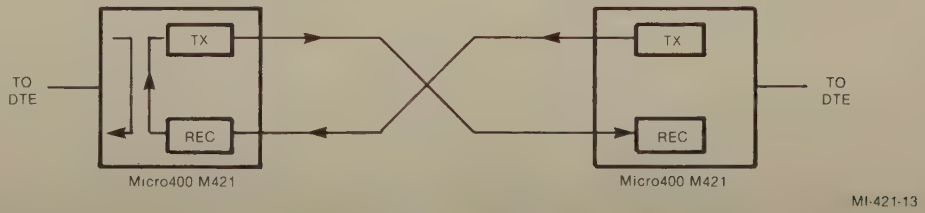
This test will verify the condition of the local and remote units and the communications link.

***CAUTION***

This test may not be valid at extreme mileage ranges. Use the full-duplex test in that circumstance.

To start this test, instruct the operator of the remote unit to depress (engage) the DLB switch. If the terminal at the local unit has loopback testing capabilities, data may be sent to the remote unit and compared with data received from the remote unit. If the terminal does not have loopback testing capabilities, the TST switch may be used in place of the DLB switch. You may determine the condition of the local and remote units, and the communications link by observing the RD light.

To end this test, depress (disengage) all test switches.




***Digital Loopback Test Data Flow***

## YOUR MICOM EQUIPMENT COMES WITH A WARRANTY

MICOM warrants that the equipment delivered shall be free from defective material and workmanship for a period of I year from the date of delivery of equipment when given normal, proper, and intended usage, and agrees to repair or replace, without cost, any part manufactured by MICOM provided that:

(a) MICOM is promptly notified upon discovery that the equipment is defective;

(b) The equipment is returned prepaid to the MICOM plant from which the equipment was shipped; **and**

(c) MICOM's examination of the equipment shall disclose that any defect was not caused by accident, misuse, neglect, alteration, improper installation, unauthorized repair, or improper testing.

MICOM may, in its sole discretion, elect to repair or replace the equipment, in which event MICOM shall have a reasonable time to make repairs or to replace the equipment. MICOM will return the equipment freight prepaid.

THE PROVISIONS OF THIS WARRANTY ARE IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND MICOM'S LIABILITY ARISING OUT OF THE MANUFACTURE, SALE, OR SUPPLYING OF THE EQUIPMENT OR ITS USE, WHETHER BASED UPON WARRANTY, CONTRACT, NEGLIGENCE, PRODUCTS LIABILITY, OR OTHERWISE, SHALL NOT EXCEED THE ORIGINAL COST TO THE BUYER OF THE EQUIPMENT. IN NO EVENT SHALL MICOM BE LIABLE TO THE BUYER OR ANY OTHER PERSON OR ENTITY FOR UNINTENDED OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR USE DAMAGES) ARISING OUT OF THE MANUFACTURE, SALE, OR SUPPLYING OF THE EQUIPMENT.

MICOM warrants all repairs or upgrades performed at its factory location or performed by MICOM Customer Service for a period of 90 days after completion.

## HOW TO GET YOUR EQUIPMENT FIXED BY MICOM CUSTOMER SERVICE

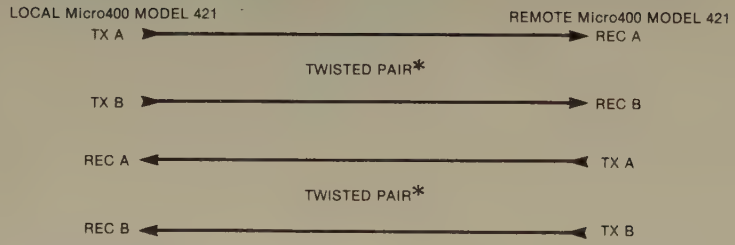
MICOM's Customer Service offers a wide range of support functions, including complete factory repair for both in-warranty and out-of-warranty equipment.

Before returning any equipment, however, please call MICOM Customer Service: contact our Eastern Regional Office at (201) 750-1120; contact our Central Regional Office at (314) 576-7626; or, in the West, contact our Corporate Office at (213) 998-8844.

A Customer Service engineer will answer warranty-related questions, discuss your specific equipment problems, and — when necessary — give you shipping instructions for returning equipment to MICOM for repair. To return any product for service or repair, you must obtain a Return Authorization number from MICOM Customer Service.

*Shipping charges must be prepaid.*

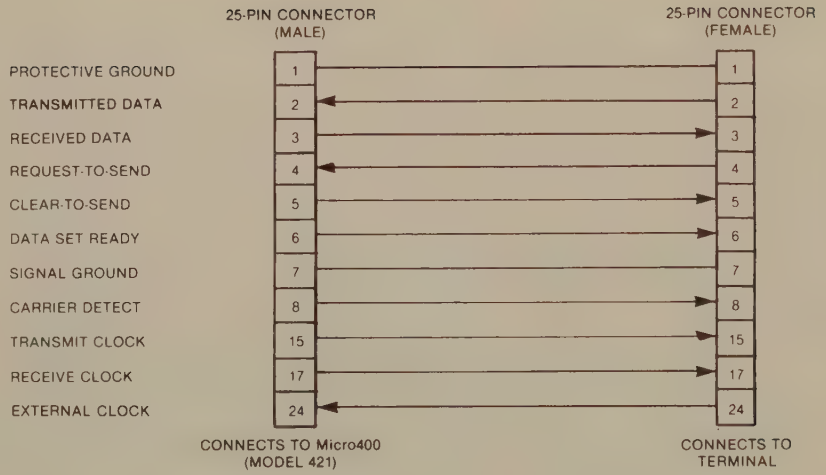
# APPENDIX A
# CABLE WIRING




*POLARITY A TO A AND B TO B MUST BE OBSERVED FOR CORRECT OPERATION.

MI-421-09

**Four-Wire Cable Connections**




***Terminal Cable Connection***

# *APPENDIX B*
# *TECHNICAL SPECIFICATIONS*

## PHYSICAL SPECIFICATIONS

*Operating Environment:* 32-122° F (0-50° C), 0-95% relative humidity

*Power:* Standalone:
*Domestic:* 115 V ac ±10%, 45-65 Hz, 5 watts
*Export:* 195-266 V ac, 45-65 Hz, 5 watts

Rack-Mount: 115 or 230 V ac ±10%, 45-65 Hz, 80 watts maximum

*Size:*

| Standalone: | Rack-Mount Chassis: |
|---|---|
| 5-1/2 inches (14.0 cm) wide | 19 inches (48.3 cm) wide |
| 1-3/4 inches ( 4.4 cm) high | 5-1/4 inches (13.3 cm) high |
| 8-1/2 inches (21.6 cm) deep | 10 inches (25.4 cm) deep |
| Weight: 2 pounds (0.9 kg) | Weight: 16 pounds (7.2 kg) |

*Types of Displays:* Received Data, Transmitted Data, and Data Set Ready

## LINE INTERFACE SPECIFICATIONS

*Cable Type:* 4-wire unloaded and loaded telephone circuits with dc continuity, or customer-owned twisted pair cable

*Signals:* For Standalone:

| | |
|---|---|
| TX-A (Transmit-A), | REC-A (Receive-A) |
| TX-B (Transmit-B), | REC-B (Receive-B) |
| REC-A (Receive-A), | TX-A (Transmit-A) |
| REC-B (Receive-B), | TX-B (Transmit-B) |

For Rack-Mount:

| | |
|---|---|
| TX-A to Pin A | REC-A to Pin E |
| TX-B to Pin B | REC-B to Pin F |

*Data Rate:* 1200, 2400, 4800, 9600, and 19,200 bps, synchronous (1200, 2400, and 4800 bps for 4-wire loaded Telco lines)

*Transmitter Output Level:* Local Datasets conform to Bell Publication 43401 (up to 9600 bps only)

*Diagnostics:* Digital loopback, Line Loopback, and Test Pattern

## TERMINAL INTERFACE SPECIFICATIONS

*Interface:* EIA RS-232-C or CCITT V. 24/28; full-duplex

*Data Rate:* 1200, 2400, 4800, 9600, and 19,200 bps, synchronous (1200, 2400, and 4800 bps for 4-wire loaded Telco lines)

*Diagnostics:* Digital Loopback

*Request-To-Send and Clear-To-Send Delay:* 0 or 8 msec

*Signals:*

| Pin | EIA RS-232-C | CCITT V.24 | Name |
|---|---|---|---|
| 1 | AA | 101 | Protective Ground |
| 2 | BA | 103 | Transmitted Data |
| 3 | BB | 104 | Received Data |
| 4 | CA | 105 | Request-To-Send |
| 5 | CB | 106 | Clear-To-Send |
| 6 | CC | 107 | Data Set Ready |
| 7 | AB | 102 | Signal Ground |
| 8 | CF | 109 | Carrier Detect |
| 15 | DB | 114 | Transmit Clock |
| 17 | DD | 115 | Receive Clock |
| 24 | DA | 113 | External Transmit Clock |

| | |
|---|---|
| *Terminal Location Requirements:* | Within 50 feet of terminal or port |
| *Control Signals:* | DSR wired high (except in test mode)<br>CD is dynamic<br>RTS/CTS dynamic |

## TRANSMISSION RANGES

Actual transmission ranges for your Model M421 will vary depending on the transmission mode and the gauge of the transmission wire used. Although transmission ranges may be affected by such variables as weather and line conditions, a typical set of transmission ranges for unloaded and loaded lines is shown in the table below and on the following page.

| Local Dataset Mode 4-Wire Full-Duplex | | | | |
|---|---|---|---|---|
| **Data Rate (in bps)** | **26 Gauge (0.15 mm²)** | **24 Gauge (0.2 mm²)** | **22 Gauge (0.4 mm²)** | **19 Gauge (1.0 mm²)** |
| 1200 | 9 | 11.7 | 13.5 | 17 |
| 2400 | 6.5 | 8.5 | 9.7 | 12 |
| 4800 | 5 | 6.5 | 7.5 | 8.5 |
| 9600 | 3.5 | 4.5 | 5.2 | 7 |
| 19200 | 3 | 4 | 4.5 | 6 |

MT-421-06

***Typical Transmission Ranges in Miles for Unloaded Lines***

| Data Rate (in bps) | Transmission Distance In Miles * |
|---|---|
| | 26 Gauge (0.15 mm²) |
| 1200 | 12 |
| 2400 | 10 |
| 4800 | 6 |
| 9600 | . . . |
| 19200 | . . . |
| * Transmissions over loaded lines are limited to 4800 bps. | |

MT-421-07

***Typical Transmission Distances on Loaded Lines***

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## MANUAL IDENTIFICATION

DATE OF MANUAL: _____ PUBLICATION NUMBER: _____ TYPE OF MANUAL: _____

EQUIPMENT COVERED: _____

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## SUGGESTED SOLUTION

DESCRIPTION:* _____

## READER IDENTIFICATION

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*The best way to help us identify and correct the problem you discovered is to include marked-up copies of the affected pages.

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